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ORIGINAL ARTICLE

Antibiotic sensitivity pattern of deep skin and soft tissue infections in Pakistan.

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ABSTRACT… Objective: To determine the antibiotic spectrum of deep skin and soft tissue infections in Pakistan. **Study Design:** Cross-sectional study. **Setting:** Department of Dermatology at Madinah Teaching Hospital, Faisalabad. **Period:** June, 2023 to December 2023. **Methods:** Inclusion criteria covered consenting patients aged 15-60, excluding those with specific conditions. The study aimed to ascertain antibiotic sensitivity patterns in deep skin and soft tissue infections. Ethical approval was obtained, and subjects meeting criteria were enrolled after informed consent, contributing valuable insights into healthcare-associated infections. **Results:** Examining 60 patients, the age distribution indicates a prevalent cohort up to 50 years (61.7%), highlighting potential health concerns in earlier years. Those above 50 constitute 38.3%, signifying distinct challenges in older age. With 61.7% males, Gram stain analysis reveals microbial diversity. Notably, Ciprofloxacin (90%) and Cefipime (98.3%) exhibit high resistance, while Cephradine (48.3%) and Cefoxitin (20%) show sensitivity. Meropenem and Vancomycin display moderate resistance (28.3% and 25%), while Tigecycline (10%) and Teicoplanin (1.7%) exhibit lower resistance, offering insights for effective treatment strategies. **Conclusion:** Our study reveals notable antibiotic resistance, with Ciprofloxacin (90%) and Cefipime (98.3%) exhibiting high resistance. Conversely, Cephradine (48.3%) and Cefoxitin (20%) show sensitivity, guiding tailored treatment strategies for deep skin and soft tissue infections.

Key words: Antibiotic Spectrum, Antibiotic Resistance, Deep Skin Infections, Microbial Sensitivity, Soft Tissue Infections.

INTRODUCTION

One of the most frequent illnesses seen in the hospitals is skin and soft tissue infections (SSTIs).[1] According to estimates from 2014, there will be 29.7 SSTI-related ER visits per 1000 people in the United States' EDs or OPDs.[2] Numerous microbes often colonise the skin without doing any damage. The pathogenic organisms proliferate throughout the skin's layers, overgrow, and cause either acute or chronic inflammation when there is an imbalance in the structural or functional protection provided by the skin.[3] Infection is the name of this phenomenon. A distant infection's hematogenous dissemination of microorganisms may cause certain skin diseases. Staphylococcus aureus and streptococci are the main causes of SSTIs.[4]

SSTIs will be divided into two categories by the US Food and Drug Administration: simple and complex infections.[5] Abscesses, cellulitis, etc represent examples of uncomplicated skin and soft tissue infections (SSTIs). These are relatively straightforward infections that typically respond well to standard treatment. On the other hand, severe infections encompass more complicated cases such as necrotizing infections, infected burn wounds, infected open ulcers, and deep abscesses requiring significant surgical intervention. These infections may involve deeper tissues and can lead to more serious complications if not promptly and effectively treated. Furthermore, infections occurring in diabetic and immunocompromised individuals are also classified as severe, as these populations are at higher risk for complications and may require more intensive management strategies.[6]

The SSTIs may be split into two categories based on the presumed source of infection: Community-acquired infections are those that affect non-hospitalized individuals, while

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healthcare-associated infections are those that happen during or soon after hospitalisation.[7] Since healthcare-associated infections are seen as a serious consequence, research on them is ongoing worldwide.

In Waheed et al.'s study, the most affected age group was 15-44 years (44.03%). Staphylococcus aureus and Escherichia coli were the predominant Gram-positive and Gram-negative bacteria, respectively. Methicillin resistance was observed in 19.60% of S. aureus and 40.74% of Coagulase-negative Staphylococci (CONS). Vancomycin was the most effective drug against Gram-positive isolates, while tigecycline showed high efficiency against all isolates. Gram-negative isolates exhibited maximum resistance to cephalosporin, ampicillin, erythromycin, and co-trimoxazole, with the least resistance against ticarcillin, tazobactam-pipiracillin, amikacin, and gentamicin.[8]

Understanding antibiotic resistance profiles and shifts in bacterial infections is vital for guiding appropriate treatments, controlling infections promptly, preventing spread to other body regions, and enhancing quality of life. However, community data on Complicated Skin and Soft Tissue Infections (CSSSI), antibiotic susceptibilities, and mortality rates are limited. This study aims to address this gap by identifying the microbiological profile, prevalence, and antibiotic susceptibilities of bacteria isolated from CSSSI samples. These findings will inform future research, refine current practices, and bolster the evidence base for this approach. Additionally, the results will support young physicians in effectively managing these cases. Nonetheless, healthcare professionals should make medication decisions by thoroughly considering relevant factors and assessing each case individually.

METHODS

The study was conducted at the Department of Dermatology in Madinah Teaching Hospital, Faisalabad, employing a cross-sectional study design over a duration of six months, following the proper approval of the synopsis (TUF/IRB/241/23 date: 27-6-23). The sampling technique utilized was Non-Probability Consecutive Sampling, with the sample size calculated using the WHO sample size calculator with reference to study.[8] Inclusion criteria encompassed patients who gave consent for treatment, both genders, and individuals aged 15 to 60 years, while exclusion criteria included patients with co-morbid conditions like diabetes and hypertension, those already using topical and systemic antibiotics, individuals with other autoimmune or inflammatory skin conditions, patients with healthcare-associated infections, and pregnant or lactating females. Upon obtaining approval from the Ethical Review Committee, the study commenced enrollment of subjects who met the operational definitions and inclusion criteria, following informed consent procedures. The study aimed to elucidate the antibiotic sensitivity pattern of deep skin and soft tissue infections (SSTIs). SSTIs were defined as microbial invasions affecting the epidermis, dermis, and subcutaneous tissues, accompanied by signs of inflammation. Specifically, any infection emerging within 48 hours after hospital admission, within three days post-discharge, or within 30 days following surgery was classified as a healthcare-associated infection (HAI). This comprehensive approach allowed for a thorough investigation into the microbial sensitivity profiles of SSTIs, contributing valuable insights into the management and treatment of these infections in clinical practice.

All relevant samples were meticulously collected following the rigorous protocols outlined by the hospital's sample collection guidelines, ensuring comprehensive coverage of infected areas. Upon receipt, all pus/wound swab samples underwent thorough processing in strict adherence to established microbiology laboratory operating guidelines. Utilizing a combination of sophisticated techniques and methodologies, isolates were systematically identified up to the species level, enabling precise classification of bacterial pathogens. This identification process involved a series of comprehensive biochemical tests, meticulously conducted by trained laboratory personnel. Subsequently, susceptibility testing was meticulously performed, meticulously following the stringent guidelines outlined by the Clinical Laboratory Standards, ensuring accuracy

and reliability in assessing the efficacy of various antimicrobial agents against the identified bacterial strains.

The antibiotics of different groups were utilized in the study, including Penicillins, Cephalosporins, Macrolides, Meropenem (10 µg) from the Carbapenem group, Aminoglycosides, Doxycycline (30 µg) from the Tetracycline group, Trimethoprim+Sulphamethoxazole (25/23.75 µg) from sulpha drugs, Glycopeptides like Vancomycin (30 µg), Tigecycline (15 µg) from the Glycycline group, Antituberculosis like Rifampicin (5 µg), and others such as Novobiocin (5 µg), Aztreonem (15 µg), clindamycin (2 µg), linezolid (30 µg), Fusidic acid (10 µg), Chloramphenicol (30 µg), Ticarcillin (75 µg), and Pipiracillin+tazobactam (40 µg).

Analysis was done using SPSS 23. Mean and standard deviation were calculated for quantitative variables like age, and frequency and percentage were calculated for qualitative variables. Data of the outcome variable were stratified for age, gender, and post-stratification chi-square was applied. A p-value < 0.05 was considered statistically significant.

RESULTS

The age distribution of the patients in this study reveals a cohort of 60 individuals, providing valuable insights into the demographic profile. The majority of the patients, constituting 61.7% of the total sample, fall within the age bracket of up to 50 years. This indicates a notable prevalence of health concerns or conditions among individuals in their earlier years, possibly reflecting a range of factors such as lifestyle, occupational risks, or genetic predispositions. On the other hand, the remaining 38.3% of the patients are aged above 50 years, suggesting that a significant portion of the study population faces health challenges associated with older age. The data underscores the importance of considering age as a relevant factor in understanding and addressing health issues within this patient population.

The gender distribution of the patient population under consideration is delineated by a total of 60 individuals. Of this total, 61.7% are male, comprising 37 patients, while the remaining 38.3% are female, accounting for 23 patients. This gender-based analysis sheds light on the composition of the study group, indicating a slight predominance of males. Such disparities in gender distribution can have implications for healthcare planning and intervention strategies, as different genders may exhibit distinct health patterns or susceptibility to certain conditions.

The data underscores the importance of considering gender as a significant demographic factor in the context of this patient population, guiding further research and interventions aimed at addressing the unique healthcare needs of both males and females within the studied cohort.

The Gram stain results from the study population of 60 individuals indicate diverse microbial compositions. A minority of cases, constituting 1.7%, exhibit the presence of both Gram-negative and Gram-positive microorganisms. This suggests a mixed microbial profile in these particular instances. The majority of cases, accounting for 50.0%, reveal the presence of only Gram-negative microorganisms, while 48.3% display exclusively Gram-positive microorganisms. These findings from the Gram stain analysis provide valuable insights into the nature of microbial infections or conditions within the studied patient population. The prevalence of Gram-negative or Gram-positive microorganisms may have diagnostic and therapeutic implications, guiding healthcare professionals in the selection of appropriate treatment strategies.

		Frequency	Percent
Age (years)	Upto 50 years	37	61.7
	>50 years	23	38.3
	Total	**60**	**100.0**
		Frequency	**Percent**
Gender	Male	37	61.7
	Female	23	38.3
	Total	**60**	**100.0**

Table-I. Showing the details of the age of the patients

	Frequency	Percent
Gram negative & positive microorganisms	1	1.7
Gram negative microorganisms	30	50.0
Gram positive microorganisms	29	48.3
Total	60	100.0

Tables-II. Showing details of the gram stain Tables-II. Showing details of the gram stain

S. No.	Antibiotic	Resistant		Sensitive	
		No. of Cases	%	No. of Cases	%
1	Doxycyclin	51	85	3	5
2	Linezolid	48	80	8	13
3	Ciprofloxacin	54	90	5	8
4	Cefipime	59	98	1	1.7
5	Gentamycin	49	81	5	8
6	Ceftazidime	30	50	1	1.7
7	Cephradine	31	51	29	48
8	Meropenem	17	28	15	25
9	Cefuroxime	32	53	--	
10	Cefoperazone-Sulbactam	1	1.7	10	17
11	Amoxicillin-ClavulanicAcid	52	86	5	8
12	Sulphamethoxazole-Trimethoprim	55	91	4	7
13	Levofloxacin	25	41	6	10
14	Ofloxacin	56	93	3	5
15	Amikacin	32	53	10	17
16	Ceftrixone	30	50	3	5
17	Tobramycin	28	46	2	3
18	Aztreonam	47	78	4	7
19	Piperacillin-Tazobactam	24	40	7	12
20	Oxacilin	19	31	-	18
21	Penicillin	30	50	28	46
22	Vancomycin	15	25	3	5
23	Erythromycin	24	40	1	1.7
24	Ampicillin	31	51	1	1.7
25	Clindamycin	23	38	4	7
26	Impenem	25	41	5	8
27	Azithromycine	28	46	1	1.7
28	Cefoxitin	17	28	12	20
29	Tigecycline	8	13	6	10
30	Teicoplanin	11	18	1	1.7
31	Fosfomycin	5	8	6	10
32	Moxifloxacin	14	23	4	7

Table-III. Showing the details of the percentage of cases showing resistance and sensitivity to various antibiotics

DISCUSSION

On human bodies, microorganisms are responsible for the majority of skin and deep infections of soft tissues.[9,10] Individuals who have atopic dermatitis are at increased danger for skin infections with significant medical reasons, but neglected cases can progress to central disease. S. aureus, one of the most frequent bacteria causing diseases in the host, frequently colonises the patient's skin due to atopic dermatitis.[11] In this context, the present investigation was founded on the examination of the antibiotic sensitivity characteristics of microbes presenting with deep skin and soft tissue infections in the district of Faisalabad, Pakistan.

Gram stain results from the study of 60 individuals show varied microbial compositions. A small proportion, 1.7%, exhibit both Gram-negative and Gram-positive microorganisms, indicating a mixed microbial profile. The majority, 50.0%, display only Gram-negative microorganisms, while 48.3% show exclusively Gram-positive microorganisms. These findings offer insights into microbial infections or conditions in the studied population, with potential diagnostic and therapeutic implications for healthcare professionals in selecting treatment strategies.

Our findings are consistent with an earlier research conducted by Khan et al. (2021), who found that E. coli (46%) bacteria were the most prevalent microbes between the other pathogens caused by bacteria, being followed by S aureus (39%), Proteus spp. (11%), Klebseilla spp. (2%), and P. aerugenosa (2%).[12] A separate investigation discovered that Microsporum spp., Trychophyton spp., Epidermophyton spp., and Aspergillus spp. were the most common dermatophytic microorganisms in human hair, human skin, and human nail tissues.[13]

Trichophyton mentagrophytes, Trichophyton rubrum, Trichophyton violaceum, Epidermophyton occosum, Microsporum gypseum, Trichophyton tonsurans, Trichophyton schoenleinii, and Trichophyton verrucosum have all been discovered in cutaneous fungal infections in a further investigation.[14] In line with these

findings, the most recent research found that the prevalence of Candida spp. was significantly greater (44.44%) than that of other pathogenic fungi, which included Aspergillus spp. (22.22%), Rhizopus spp. (16.16%), Mucor spp. (11.11%), and P. lilacin us (5.55%).

In accordance with the findings of Khan et al.[12], E. coli was 90% susceptible to Amikacin and 95% resilient to Ampicillin. S aureus was found to be very responsive to both Meropenem and Doxycycline (92.1%) and exceptionally resillient to Levofloxacin (91.1%). Proteus spp. exhibited 100% sensitivity to Meropenem and 90% immunity to Doxycycline. Klebsiella spp. shown 100% sensitivity to Ciprooxacin, Cefotaxime, Aztreonam, and Doxycycline but 100% resistant towards Meropenem and Amoxicillin. P. aeruginosa was 100% sensitive to Amikacin, Meropenem, Ciprooxacin, Gentamicin, Cefotaxime, Ceftriaxone, Ampicillin, and Cefotaxime but 100% resistant to Aztreonam and Doxycycline.[12]

In line with earlier research, the responsiveness profile of the organism revealed that E. coli was resistant to amoxicillin (86.95%) but extremely susceptible to amikacin (86.95%). S. aureus had strong immunity to Ciprofloxacin, Levofloxacin (84.61%), and Doxycycline and Cefotaxime (92.3%). Klebsiella spp. was discovered to have 100% immunity to Amoxicillin and Meropenem while being 100% susceptible to Cefotaxime, Doxycycline, and Aztreonam. Proteus spp. has shown considerable inability to Ciprofloxacin and Amoxicillin (81.81%), but is extremely susceptible to Meropenem (100%). P. aeruginosa was entirely intolerant to Doxycycline and Aztreonam, but completely susceptible to Cefotaxime, Meropenem, Amikacin, Ampicillin, Ceftriaxone, Gentamicin, and Ciprofloxacin. In the research we conducted, the responsiveness behaviour of the fungi revealed that candida spp. was exceptionally resistant to Nystatin (87%), but extremely susceptible to Fluconazole (100%). Aspergillus spp. were discovered to be extremely refractory to Nystatin (100%) and particularly susceptible to itraconazole and fluconazole (75%). Mucor spp. had 100% immunity to Fluconazole, Ketoconazole, and Clotrimazole despite being 100% susceptible to Nystatin. Rhizopus spp. was shown to be completely impervious to itraconazole and completely dependent upon nystatin. P. lilacinus was shown to be highly immune to itraconazole and nystatin (100%), but susceptible to ketoconazole, clotrimazole, and fluconazole. According to the earlier research, the following antifungal medicines are among those frequently prescribed for managing dermatophytosis: fluconazole, miconazole, clotrimazole, ketoconazole, griseofulvin, and terbinafine.[11]

RECOMMENDATIONS

Based on the demographic findings, it's recommended to tailor healthcare interventions to address the prevalent age groups identified. For individuals up to 50 years, focus on preventive measures, lifestyle modifications, and early detection programs may help mitigate health concerns. For those above 50, interventions should target age-related health challenges, including chronic conditions and geriatric care.

Regarding gender distribution, healthcare planning should consider the slight predominance of males, ensuring equitable access to services for both genders. Tailored interventions may be necessary to address gender-specific health patterns and susceptibilities effectively. Additionally, raising awareness about gender-specific health risks and promoting gender-sensitive healthcare delivery could enhance overall health outcomes.

For the microbial compositions identified through Gram staining, treatment protocols should be tailored based on the specific microbial profile. This may involve selecting antibiotics with demonstrated sensitivity to the predominant microorganisms while considering the potential for mixed infections. Further research into antimicrobial resistance patterns and treatment efficacy can inform evidence-based prescribing practices to optimize patient outcomes.

LIMITATIONS

The research's limitations were minor, and a

molecular analysis was also required to uncover the antibiotic resistance gene and pathogenicity of these infections.

CONCLUSION

In summary, our study of 60 patients with deep skin and soft tissue infections reveals notable antibiotic resistance. Ciprofloxacin (90%), Cefipime (98.3%), and Doxycyclin (85%) exhibit high resistance, while Cephradine (48.3%), Cefoxitin (20%), and Amikacin (16.7%) show significant sensitivity. Meropenem (28.3%) and Vancomycin (25%) demonstrate moderate resistance, while Tigecycline (10%) and Teicoplanin (1.7%) display lower resistance. These insights guide targeted antibiotic choices for effective treatment strategies, emphasizing the importance of tailored approaches in managing these infections.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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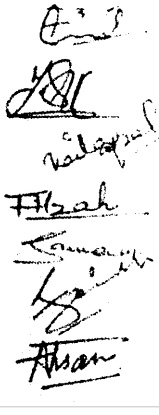
1	Tassmia Afzal	Data collectio, Entery and Analysis.	
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